

## PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2004-293336

(43)Date of publication of application : 21.10.2004

(51)Int.Cl.

F04B 39/00  
F04C 23/02  
F04C 29/00

(21)Application number : 2003-083510

(71)Applicant : MITSUBISHI ELECTRIC CORP

(22)Date of filing : 25.03.2003

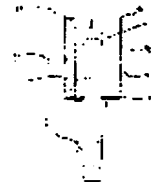
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## (54) SEALED TYPE COMPRESSOR

## (57)Abstract:

PROBLEM TO BE SOLVED: To inexpensively manufacture a compressor capable of enduring a rotational torque by affixing a rotor and a rotary shaft in a manner not to demagnetize a permanent magnet, because a cylindrical rotary shaft provided with a notch part at one axial part is fitted and fixed with a rotor having an inside diameter shape similar to a shape of the rotary shaft with the notch part.

SOLUTION: A motor is equipped with a rotor having a permanent magnet using a ferrite magnet. A cylindrical rotary shaft provided with a notch at one axial part is fitted and fixed with a rotor having an inside diameter shape similar to a shape of the rotary shaft with the notch part.



## LEGAL STATUS

[Date of request for examination]

20.01.2006

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the  
examiner's decision of rejection or application converted  
registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of  
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[Date of extinction of right]

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**CLAIMS**

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[Claim(s)]

[Claim 1]

The hermetic type compressor characterized by having inserted in shaft orientations part the revolving shaft of the cylindrical shape which prepared the notch, the revolving shaft with this notch, and each other's rotator with the bore configuration of a similarity configuration, and fixing to them.

[Claim 2]

The hermetic type compressor according to claim 1 characterized by having inserted each other in and using eye a thermal insert for immobilization.

[Claim 3]

A notch configuration is a hermetic type compressor according to claim 1 or 2 characterized by considering as D cut.

[Claim 4]

The shaft-orientations location of a notch is a hermetic type compressor according to claim 1 to 3 characterized by having arranged at the revolving-shaft edge.

[Claim 5]

It is the hermetic type compressor according to claim 1 to 4 which a rotator carries out the laminating of the sheet metal, is constituted, and is characterized by having accomplished the laminating immobilization with caulking, having made the long side of the caulking in agreement with radial, and preparing it.

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DETAILED DESCRIPTION

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## [Detailed Description of the Invention]

[0001]

## [Field of the Invention]

This invention relates to the compressor used for an air-conditioner, a refrigerator, etc.

[0002]

## [Description of the Prior Art]

As for a general hermetic type compressor, a permanent magnet is embedded at the stator of a motor. With a low capacity compressor, a cheap ferrite magnet is especially used for a permanent magnet in many cases. It was thermal insert carried out of the rotator to the revolving shaft which carried out the shape of a cylindrical shape, and the rotator inside diameter was slightly manufactured more smallish from the revolving-shaft dimension, by what (for example, 200 degrees C - 300 degrees C) a rotator is heated for, the bore was made to expand, the revolving shaft was inserted in, burned and inserted in, and the method is taken (for example, refer to patent reference).

[0003]

## [Patent reference]

JP,09-215237,A

JP,09-233752,A

[0004]

## [Problem(s) to be Solved by the Invention]

Although it demagnetizes at an elevated temperature and \*\*\*\*\* and demagnetization initiation temperature are based on the permeance of a magnetic circuit when with a Curie temperature [ below ] (about 460 degrees C) there is no fear of demagnetization and eye a thermal insert is made, when the conventional hermetic type compressor is constituted as mentioned above and the ferrite magnet is being used for a rotator, but using the rare earth magnet of high magnetism, it begins to demagnetize at 150 degrees C - 200 degrees C of outlines. Therefore, fixing [ / a thermal insert ] becomes very difficult.

[0005]

Moreover, for example, while what has taken D mold structure required the floor to floor time of a revolving shaft and becoming expensive about the whole revolving shaft, when the revolving shaft and the rotator were made eye a running fit had path clearance, there was a trouble that will become what has a bad precision and press fit, then a manufacturing facility will become large-scale.

[0006]

## [Means for Solving the Problem]

The compressor concerning this invention inserts in shaft orientations part the revolving shaft of the cylindrical shape which prepared the notch, a revolving shaft with this notch, and each other's rotator with the bore configuration of a similarity configuration, and fixes to them.

[0007]

## [Embodiment of the Invention]

## The gestalt 1 of operation

Hereafter, the gestalt of implementation of this invention is explained based on drawing. The sectional view showing the revolving shaft of a compressor [ in / in drawing 1 / the gestalt of implementation of this invention ], The plan showing the revolving shaft of the compressor according [ drawing 2 ] to the gestalt 1 of implementation of this invention, The sectional view showing the rotator of the compressor according [ drawing 3 ] to the gestalt 1 of implementation of this invention, the sectional view showing a hole for the up half moon of the rotator of the compressor according [ drawing 4 (a) ] to the gestalt 1 of implementation of this invention, and drawing 4 (b) are the sectional views showing the lower circular hole of the rotator of the compressor by the gestalt 1 of implementation of this invention. The sectional view and drawing 6 which show the condition that drawing 5 was able to insert in the revolving shaft and the rotator are the sectional view of the compressor in which the condition of having included the revolving shaft and rotator by the gestalt 1 of implementation of this invention in the compressor is shown. When the revolving shaft 1 is connected with the compression element section 2 as shown in drawing, rotating magnetic field occur in the stator 5 fixed to the well-closed container 4 by the current supplied from the power supply terminal 3 and the revolving shaft 1 which a rotator 6 rotates by this rotating magnetic field, and was mutually inserted in with the rotator 6 rotates, the compression element section 2 operates, a refrigerant gas is compressed, and actuation as a compressor is performed.

[0008]

A rotator 6 is equipped with the permanent magnet 8 using the rare earth magnet with which the magnetic steel sheet of sheet metal was embedded in the iron core 7 by which the laminating was carried out, and this iron core 7, it arranges the end plate 9 made from non-magnetic material to the both ends of an iron core 7 so that the fragment of this permanent magnet 8 may not jump out all over a refrigerant circuit, and it is fixing both ends in the rivet 10 grade.

[0009]

Here, as shown in a revolving shaft 1 at drawing 1, notch 1a is formed, and on the other hand, the revolving-shaft insertion opening 11 which includes a configuration for the half moon used as said notch 1a and similarity is formed in the bore section of a rotator 6. Notch fit section 11a of the half moon configuration of insertion opening 1 side edge and insertion opening 11b of a circle configuration are the parts used as revolving-shaft notch 1a and a similarity configuration among this revolving-shaft insertion opening 11. The condition that said revolving shaft 1 and rotator 6 were inserted in drawing 5 is shown. The revolving shaft 1 and the rotator 6 are being burned, inserted in and fixed. Namely, the outer diameter of a revolving shaft 1 and the dimension of notch 1a are made

more greatly several micrometers - dozens of micrometers than the bore (revolving-shaft insertion opening) of a rotator 6, and the dimension of notch fit section 11a. The bore (revolving-shaft insertion opening) of a rotator 6 is made to expand more than the diameter of a revolving shaft, and a revolving shaft 1 is inserted in the condition, and by heating a rotator 6 at induction heating or a furnace, when a rotator 6 cools after that, a bore tends to return, and a revolving shaft 1 is bound tight and it is fixed.

[0010]

The amount of expansion of the rotator bore (revolving-shaft insertion opening) by heating is expressed with a degree type. namely  $\Delta d = \alpha \Delta t \cdot d$

$\Delta d$ : The amount of bore expansion,

$\alpha$ : Coefficient of linear expansion of a magnetic steel sheet,

$d$ : The original bore,  $t$ : temperature gradient,

The relation between whenever [ stoving temperature ], and the amount of bore expansion is shown like drawing 7 (a).

[0011]

It will become possible to insert in, if whenever [ stoving temperature ] turns into beyond the temperature  $a$  that becomes more than the outer diameter of a revolving shaft 1. At the time of operation of a compressor, with a compression load, since torque occurs between a rotator 6 and a revolving shaft 1, torque holding power must be secured to a rotator 6 and a revolving shaft 1 so that this torque may be overcome. What is necessary is for what is necessary to be just to enlarge the bolting force of a rotator 6, to burn it, to insert it in, and just to enlarge the front revolving shaft 1 and variation of tolerance of a rotator bore, in order to enlarge this holding power. That is, it is necessary to make whenever [ rotator stoving temperature ] high and to extend a small rotator bore greatly.

[0012]

It is shown that drawing 7 (b) can make the initial bore of a rotator small, and can make holding power high, so that the relation of the torque holding power of whenever [ rotator stoving temperature ], a rotator, and a revolving shaft is shown and temperature becomes high. The torque and the safety factor of a compressor are considered, and if need holding power is  $F_c$ , whenever [ stoving temperature ] is needed more than  $c$ . However, the rare earth magnet of high magnetism has been used for a permanent magnet more often for the purpose of a high increase in power and efficient-izing in recent years. If temperature and demagnetization have a relation like drawing 7 (c) and are heated beyond a certain temperature, a magnet will demagnetize a rare earth magnet (a Nd-Fe-B system, a Sm-Co system, Sm-Fe system), and the engine performance of a compressor will fall. This is a property contrary to the conventionally common ferrite magnet (the receiving proof stress of a ferrite magnet over demagnetization is as strong as an elevated temperature.).

However, below Curie temperature

[0013]

Although demagnetization initiation temperature changes with permeances which become settled with a magnetic class (coercive force), a configuration, a dimension, the configuration of an iron core, the magnitude of an air gap, etc. Usually, in order to be restrained by demagnetization in many cases and to prevent demagnetization if it is going to secure need holding power when designing the motor for compressors After having dropped the motor efficiency, performing the demagnetization cure design or attaching [ \*\*\*\* / applying cost ] a rotator and a revolving shaft, it was carrying out changing into the production process which magnetizes a magnet etc. In order for modification of a production process to become what has a large-scale facility or to simplify a facility, when magnetizing using a stator winding, it cannot fully magnetize, or a damage will be given to a coil in order to pass a high current to a stator winding. In recent years, in especially the stator of the concentrated-winding method adopted for efficient-izing, this inclination (magnetization insufficiency, coil damage) is large.

[0014]

However, since the compressor in this invention prepares notch 1a in some revolving shafts 1 and forms also in the bore section of a rotator 6 notch fit section 11a which is the part of a similarity configuration, it can enlarge torque holding power.

[0015]

In drawing 7 (c), whenever [ stoving temperature ], even if it does not demagnetize  $b$  or demagnetizes some, it is the amount of demagnetization of extent which does not affect the compressor engine performance, and it burns at the time of this temperature  $b$ , and inserts in, and torque holding power turns into the small holding power  $F_b$  from the need holding power  $F_c$ . Notch 1a and notch fit section 11a inserted in it compensate this torque holding power insufficiency  $F_c - F_b$ . Temperature  $b$  is beyond the temperature  $a$  here. It meets, and if there is nothing, it cannot burn, insert in and do. Here, although it is possible to give torque holding power only by notch 1a, without making the revolving shaft 1 smaller than a rotator bore beforehand, burning and carrying out eye \*\*, notch 1a cannot be held to the omission of the vertical direction of a rotator 6, although maintenance of the direction of torque (hand of cut) can be performed. this invention is burned, inserted in, come out of and held to the rotator omission of shaft orientations, about torque maintenance of a hand of cut, burns and inserts in and holds the force by notch 1a. Therefore, temperature  $b$  secures the holding power  $F_b$  which can prevent the rotator omission of shaft orientations, and a permanent magnet is set as the temperature out of which a property top problem does not come by demagnetization.

[0016]

Drawing 8 is the front view showing the revolving shaft of other compressors by the gestalt 1 of implementation of this invention.

Drawing 9 is the plan showing other revolving shafts of the compressor by the gestalt 1 of implementation of this invention. In drawing, what is necessary is just the configuration which establishes some cylindrical revolving shafts 1 for a notch and 2nd notch 1b, and can hold the force of a hand of cut. As shown in said drawing 1 thru/or drawing 5, a manufacture target is simple for D cut which omitted some cylindrical revolving shafts simply, and cost becomes cheap.

[0017]

Drawing 10 is the front view showing the revolving shaft of other compressors by the gestalt 1 of implementation of this invention.

Drawing 11 is the plan showing the rotator of the compressor by the gestalt 1 of implementation of this invention. In drawing, what is necessary is just the configuration which establishes some cylindrical revolving shafts 1 for a notch and 3rd notch 1c, and can hold the force of a hand of cut.

[0018]

Moreover, preparing in a reverse edge is [ the 1st notch 1a shown in drawing 1, drawing 8, and drawing 10, the 2nd notch 1b, and 3rd notch 1c / the compression element section 2 of a revolving shaft 1 ] most efficient on production.

[0019]

Drawing 12 is drawing of longitudinal section showing the iron core of other rotators by the gestalt 1 of implementation of this invention. In drawing, a rotor core 7 corresponds the caulking projected part 13 with the magnetic steel sheet 12 of sheet metal, corresponds the long side of caulking with radial with an oversized path from rotator 1 path, is established, carries out several multi-sheet laminating, and is formed. It is closed whether this laminating is automatic within iron core blanking metal mold by pressing each other's caulking projected part 13 fit.

[0020]

The plan and drawing 14 which show the iron core of other rotators according [ drawing 13 ] to the gestalt 1 of implementation of this invention are the caulking important section detail drawing of the iron core of other rotators by the gestalt 1 of implementation of this invention, and the projecting important section plan to which (a) is called V caulking, the projecting cross-sectional view where (b) is called V caulking, the projecting important section plan to which (c) is called \*\*\*\* caulking, and (d) are projecting cross-sectional views called \*\*\*\* caulking. In drawing, since the inclination of a V type attaches the direction of a x axis, although V caulking is weak, it is a thing strong against a gap of the direction of the y-axis to the gap of the direction of a x axis. Although \*\*\*\* caulking does not attach the inclination, since [ that the direction of the y-axis is longer than the direction of a x axis ] resistance is strong, the proof stress over a gap becomes a certain thing.

[0021]

Although this invention is what gives the torque holding power of a hand of cut by notch 1a, at this time, shearing force will be produced in rotor core section 7a corresponding to the boundary of notch 1a of a revolving shaft 1, and a cylindrical part. If a major axis (x directions) is set by radial [ of a rotor core 7 ] for the caulking section 14, it will become that with which maintenance is compensated to shearing by hand-of-cut torque, and the rigidity of a rotator will be made to increase here.

[0022]

Moreover, a caulking configuration can acquire the same effectiveness, if it carries out in the direction with which shearing according that high intensity direction to hand-of-cut torque will be compensated if this V caulking and not only \*\*\*\* caulking but round-head trapezoid caulking etc. has a difference in the reinforcement to a gap.

[0023]

In addition, the compressor in connection with this invention is not restricted to a rotary form compressor which expressed to drawing 3, and can be adopted as which types, such as a reciprocating mold, a scroll type, and a screw mold, of compressor.

[0024]

[Effect of the Invention]

As mentioned above, since according to this invention it inserted in shaft orientations part the revolving shaft of the cylindrical shape which prepared the notch, the revolving shaft with this notch, and each other's rotator with the bore configuration of a similarity configuration and fixed to them, a rotator and a revolving shaft are made to fix so that a permanent magnet may not be made to demagnetize, and the compressor which can bear hand-of-cut torque can be manufactured cheaply.

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the revolving shaft of the compressor by the gestalt 1 of implementation of this invention.

[Drawing 2] It is the plan showing the revolving shaft of the compressor by the gestalt 1 of implementation of this invention.

[Drawing 3] It is the sectional view showing the rotator of the compressor by the gestalt 1 of implementation of this invention.

[Drawing 4] There is (a) with the cross-sectional view showing the rotator of the compressor by the gestalt 1 of implementation of this invention.

[Drawing 5] It is the sectional view showing the condition that the revolving shaft and rotator by the gestalt 1 of implementation of this invention were able to be inserted in.

[Drawing 6] It is inclusion about the revolving shaft and rotator by the gestalt 1 of implementation of this invention at a compressor -- it is the sectional view of the compressor in which a condition is shown.

[Drawing 7] It is whenever [ stoving temperature / of the revolving shaft and rotator by the gestalt 1 of implementation of this invention ], the amount of bore expansion, torque holding power, and the property Fig. showing the relation of a demagnetizing factor, and (a) is [ torque holding power and (c of the amount of bore expansion and (b)) ] demagnetizing factors.

[Drawing 8] It is the sectional view showing the revolving shaft of other examples by the gestalt 1 of implementation of this invention.

[Drawing 9] It is the plan showing the revolving shaft of other examples by the gestalt 1 of implementation of this invention.

[Drawing 10] It is the front view showing the revolving shaft of other examples by the gestalt 1 of implementation of this invention.

[Drawing 11] It is the plan showing the rotator of other examples by the gestalt 1 of implementation of this invention.

[Drawing 12] It is drawing of longitudinal section showing the iron core of other rotators by the gestalt 1 of implementation of this invention.

[Drawing 13] It is the plan showing the iron core of other rotators by the gestalt 1 of implementation of this invention.

[Drawing 14] It is the caulking important section detail drawing of the iron core of other rotators by the gestalt 1 of implementation of this invention, and, for (a), the plan of V caulking configuration and (b) are [ the plan of a \*\*\*\* caulking configuration and (d of the cross-sectional view of V caulking configuration and (c)) ] the cross-sectional views of a \*\*\*\* caulking configuration.

[Description of Notations]

1 Revolving shaft, 1a A notch, 2 The compression element section, 3 A power supply terminal, 4 A well-closed container, 5 A stator, 6 A rotator, 7 An iron core, 8 A permanent magnet, 9 An end plate, 10 A rivet, 11 Revolving-shaft insertion opening, 11a Revolving-shaft notch, 11b The notch fit section, 12 A magnetic steel sheet, 13 Caulking projected part.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the revolving shaft of the compressor by the gestalt 1 of implementation of this invention.

[Drawing 2] It is the plan showing the revolving shaft of the compressor by the gestalt 1 of implementation of this invention.

[Drawing 3] It is the sectional view showing the rotator of the compressor by the gestalt 1 of implementation of this invention.

[Drawing 4] There is (a) with the cross-sectional view showing the rotator of the compressor by the gestalt 1 of implementation of this invention.

[Drawing 5] It is the sectional view showing the condition that the revolving shaft and rotator by the gestalt 1 of implementation of this invention were able to be inserted in.

[Drawing 6] It is inclusion about the revolving shaft and rotator by the gestalt 1 of implementation of this invention at a compressor -- it is the sectional view of the compressor in which a condition is shown.

[Drawing 7] It is whenever [ stoving temperature / of the revolving shaft and rotator by the gestalt 1 of implementation of this invention ], the amount of bore expansion, torque holding power, and the property Fig. showing the relation of a demagnetizing factor, and (a) is [ torque holding power and (c of the amount of bore expansion and (b)) ] demagnetizing factors.

[Drawing 8] It is the sectional view showing the revolving shaft of other examples by the gestalt 1 of implementation of this invention.

[Drawing 9] It is the plan showing the revolving shaft of other examples by the gestalt 1 of implementation of this invention.

[Drawing 10] It is the front view showing the revolving shaft of other examples by the gestalt 1 of implementation of this invention.

[Drawing 11] It is the plan showing the rotator of other examples by the gestalt 1 of implementation of this invention.

[Drawing 12] It is drawing of longitudinal section showing the iron core of other rotators by the gestalt 1 of implementation of this invention.

[Drawing 13] It is the plan showing the iron core of other rotators by the gestalt 1 of implementation of this invention.

[Drawing 14] It is the caulking important section detail drawing of the iron core of other rotators by the gestalt 1 of implementation of this invention, and, for (a), the plan of V caulking configuration and (b) are [ the plan of a \*\*\*\* caulking configuration and (d of the cross-sectional view of V caulking configuration and (c)) ] the cross-sectional views of a \*\*\*\* caulking configuration.

[Description of Notations]

1 Revolving shaft, 1a A notch, 2 The compression element section, 3 A power supply terminal, 4 A well-closed container, 5 A stator, 6 A rotator, 7 An iron core, 8 A permanent magnet, 9 An end plate, 10 A rivet, 11 Revolving-shaft insertion opening, 11a Revolving-shaft notch, 11b The notch fit section, 12 A magnetic steel sheet, 13 Caulking projected part.

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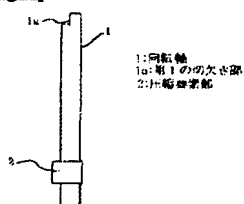
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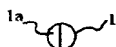
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## DRAWINGS

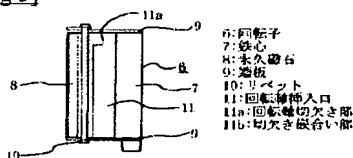
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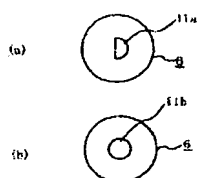
[Drawing 2]



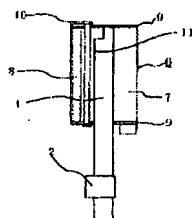
[Drawing 3]



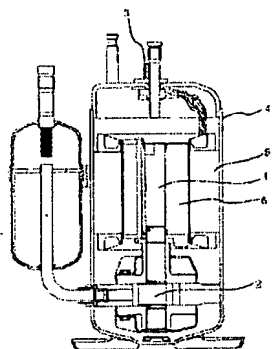
[Drawing 4]



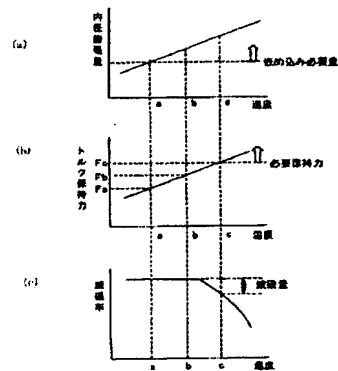
[Drawing 5]



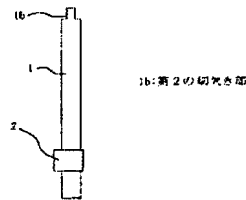
[Drawing 6]



[Drawing 7]



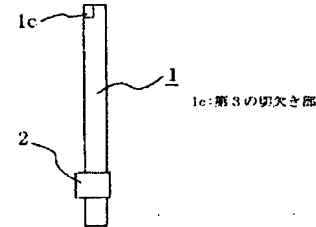
[Drawing 8]



[Drawing 9]



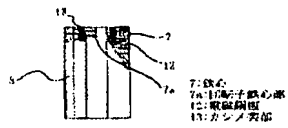
[Drawing 10]



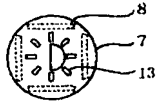
[Drawing 11]



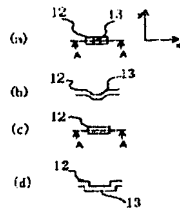
[Drawing 12]



[Drawing 13]



[Drawing 14]



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## CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law  
 [Section partition] The 1st partition of the 5th section  
 [Publication date] March 9, Heisei 18 (2006. 3.9)

[Publication No.] JP,2004-293336,A (P2004-293336A)  
 [Date of Publication] October 21, Heisei 16 (2004. 10.21)  
 [Annual volume number] Public presentation / registration official report 2004-041  
 [Application number] Application for patent 2003-83510 (P2003-83510)  
 [International Patent Classification]

F04B 39/00 (2006.01)  
 F04C 23/02 (2006.01)  
 F04C 29/00 (2006.01)  
 [FI]

F04B 39/00 103 D  
 F04B 39/00 106 D  
 F04C 23/02 E  
 F04C 29/00 A

[Procedure revision]  
 [Filing Date] January 20, Heisei 18 (2006. 1.20)  
 [Procedure amendment 1]  
 [Document to be Amended] Specification  
 [Item(s) to be Amended] Claim  
 [Method of Amendment] Modification  
 [The contents of amendment]  
 [Claim(s)]  
 [Claim 1] The hermetic type compressor characterized by having inserted in shaft orientations part the revolving shaft of the cylindrical shape which prepared the notch, the revolving shaft with this notch, and each other's rotator with the bore configuration of a similarity configuration, and fixing to them.  
 [Claim 2] The hermetic type compressor according to claim 1 characterized by having inserted each other in and using eye a thermal insert for immobilization.  
 [Claim 3] A notch configuration is the claim 1 publication characterized by considering as D cut, or a hermetic type compressor according to claim 2.  
 [Claim 4] A notch shaft-orientations location is a hermetic type compressor according to claim 1 to 3 characterized by having arranged at the revolving-shaft edge.  
 [Claim 5] It is the hermetic type compressor according to claim 1 to 4 which a rotator carries out the laminating of the sheet metal, is constituted, and is characterized by having accomplished the laminating immobilization with caulking, having made the long side of the caulking in agreement with radial, and preparing it.  
 [Claim 6] The hermetic type compressor according to claim 1 to 5 characterized by arranging a rare earth magnet to a rotator.

[Translation done.]

(19) 日本国特許庁(JP)

## (12) 公開特許公報(A)

(11) 特許出願公開番号

特開2004-293336

(P2004-293336A)

(43) 公開日 平成16年10月21日(2004.10.21)

(51) Int. Cl.<sup>7</sup>

F04B 39/00

F04C 23/02

F04C 29/00

F1

F04B 39/00

F04B 39/00

F04C 23/02

F04C 29/00

103D

106D

E

A

テーマコード(参考)

3H003

3H029

審査請求 未請求 請求項の数 5 O L (全 8 頁)

(21) 出願番号 特願2003-83510 (P2003-83510)

(22) 出願日 平成15年3月25日(2003.3.25)

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(54) 【発明の名称】 密閉型圧縮機

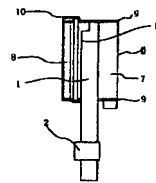
## (57) 【要約】

【課題】従来、回転子にフェライト磁石を使用している場合は、キュリー温度(約460℃)以下であれば減磁の恐れがなく、焼嵌めができるが、高磁力の希土類磁石を使用する場合は、高温で減磁し易く、減磁開始温度は磁気回路のパーミアンスによるが、焼嵌めによる固着は非常に困難となり、回転軸全体をD型構造をとっているものは、回転軸の加工時間がかかり、高価なものになるとともに回転軸と回転子をクリアランスを持った隙間嵌めにすると、精度が悪いものになる等の問題があった。

【解決手段】この発明は、フェライト磁石を用い永久磁石を備えた回転子を設けた電動機において、軸方向一部に切り欠きを設けた円筒形の回転軸と、この切り欠き部付きの回転軸と相似形状の内径形状を持つ回転子とを嵌め合い固定した。

【選択図】

図5



## 【特許請求の範囲】

## 【請求項 1】

軸方向一部に切欠き部を設けた円筒形の回転軸と、この切欠き部付きの回転軸と相似形状の内径形状を持つ回転子とを嵌め合い固定したことを特徴とする密閉型圧縮機。

## 【請求項 2】

嵌め合い固定に焼嵌めを用いたことを特徴とする請求項 1 記載の密閉型圧縮機。

## 【請求項 3】

切欠き形状は D カットとしたことを特徴とする請求項 1 又は請求項 2 記載の密閉型圧縮機。

## 【請求項 4】

切欠きの軸方向位置は、回転軸端部に配置したことを特徴とする請求項 1 乃至請求項 3 に記載の密閉型圧縮機。

## 【請求項 5】

回転子は薄板を積層して構成され、その積層固定はカシメによって成され、そのカシメの長辺を半径方向に一致させて設けたことを特徴とする請求項 1 乃至請求項 4 記載の密閉型圧縮機。

## 【発明の詳細な説明】

## 【0001】

## 【発明の属する技術分野】

本発明はエアコン、冷蔵庫などに用いられる圧縮機に関するものである。

## 【0002】

## 【従来の技術】

一般的な密閉型圧縮機は、電動機の固定子に永久磁石が埋め込まれ、特に、低容量圧縮機では永久磁石には安価なフェライト磁石が用いられることが多く、回転子は円筒形状をした回転軸に焼嵌めされ、回転子内径寸法を回転軸寸法よりわずかに小さめに製造し、回転子を加熱する（例えば 200℃～300℃）ことによって、内径を拡大させ回転軸を嵌め込む焼き嵌め方式をとっている（例えば、特許文献参照）。

## 【0003】

## 【特許文献】

特開平 09-215237 号公報

特開平 09-233752 号公報

## 【0004】

## 【発明が解決しようとする課題】

従来の密閉型圧縮機は以上のように構成されており、回転子にフェライト磁石を使用している場合は、キュリー温度（約 460℃）以下であれば減磁の恐れがなく、焼嵌めができるが、高磁力の希土類磁石を使用する場合は、高温で減磁しやすく、減磁開始温度は磁気回路のパーミアンスによるが、概略 150℃～200℃で減磁し始める。よって、焼嵌めによる固着は非常に困難となる。

## 【0005】

また、例えば、回転軸全体を D 型構造をとっているものは、回転軸の加工時間がかかり、高価なものになるとともに回転軸と回転子をクリアランスを持った隙間嵌めにすると、精度が悪いものになるし、圧入とすれば製造設備が大掛かりなものになってしまうという問題点があった。

## 【0006】

## 【課題を解決するための手段】

この発明に係る圧縮機は、軸方向一部に切欠き部を設けた円筒形の回転軸と、この切欠き部付きの回転軸と相似形状の内径形状を持つ回転子を嵌め合い固定したものである。

## 【0007】

## 【発明の実施の形態】

実施の形態 1.

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以下、この発明の実施の形態を図に基づいて説明する。図1はこの発明の実施の形態における圧縮機の回転軸を示す断面図、図2はこの発明の実施の形態1による圧縮機の回転軸を示す上面図、図3はこの発明の実施の形態1による圧縮機の回転子を示す断面図、図4(a)はこの発明の実施の形態1による圧縮機の回転子の上部半月穴を示す断面図、図4(b)はこの発明の実施の形態1による圧縮機の回転子の下部円穴を示す断面図である。図5は回転軸と回転子を嵌め合わされた状態を示す断面図、図6はこの発明の実施の形態1による回転軸と回転子を圧縮機に組込んだ状態を示す圧縮機の断面図である。図に示すように、回転軸1は圧縮要素部2と連結されており、電源端子3より供給された電流により密閉容器4に固定された固定子5に回転磁界が発生し、この回転磁界によって回転子6が回転し、回転子6と嵌め合われた回転軸1が回転することによって、圧縮要素部2が動作し、冷媒ガスを圧縮し圧縮機としての動作を行っている。

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#### 【0008】

回転子6は、薄板の電磁鋼板が積層された鉄心7と、この鉄心7に埋め込まれた希土類磁石を用いた永久磁石8を備え、この永久磁石8の破片が冷媒回路中に飛び出ないように鉄心7の両端部に非磁性体製の端板9を配置し、リベット10等で両端部を固定している。

#### 【0009】

ここで、回転軸1には図1に示すように切欠き部1aが形成されており、一方、回転子6の内径部には、前記切欠き部1aと相似となる半月形状を含む回転軸挿入口11が形成されている。この回転軸挿入口11のうち挿入口一側端の半月形状の切欠き嵌合い部11aと円形状の挿入口11bが回転軸切欠き部1aと相似形状となっている部分である。図5には前記回転軸1と回転子6が嵌め合わされた状態を示す。回転軸1と回転子6は焼き嵌め固定されている。すなわち、回転軸1の外径と切欠き部1aの寸法は回転子6の内径(回転軸挿入口)と切欠き嵌合い部11aの寸法よりも数 $\mu\text{m}$ ~数十 $\mu\text{m}$ 大きく作られており、回転子6を誘導加熱や炉で加熱することにより回転子6の内径(回転軸挿入口)を回転軸径以上に拡大させ、その状態で回転軸1を挿入し、その後回転子6が冷却することによって内径が元に戻ろうとして回転軸1を締め付け固定されるものである。

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#### 【0010】

加熱による回転子内径(回転軸挿入口)の膨張量は次式で表される。即ち、

$$\Delta d = \alpha \times d \times t$$

$\Delta d$  : 内径膨張量、

$\alpha$  : 電磁鋼板の線膨張係数、

$d$  : 元の内径、 $t$  : 温度差、

加熱温度と内径膨張量の関係は図7(a)のように示される。

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#### 【0011】

加熱温度は回転軸1の外径以上となる温度 $a$ 以上となれば、嵌め込むことは可能となる。圧縮機の運転時には圧縮負荷により、回転子6と回転軸1の間にトルクが発生するため、このトルクに打ち勝つように回転子6と回転軸1にはトルク保持力を確保しなければならない。この保持力を大きくするためには、回転子6の締め付け力を大きくしてあげればよく、焼き嵌め前の回転軸1と回転子内径の寸法差を大きくすればよい。即ち、回転子加熱温度を高くし、小さな回転子内径を大きく広げる必要がある。

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#### 【0012】

図7(b)は回転子加熱温度と回転子、回転軸のトルク保持力の関係を示したものであり、温度が高くなるほど、回転子初期内径を小さくでき、保持力を高くできることを示している。圧縮機のトルクと安全率を考え、必要保持力が、 $F_c$ であれば加熱温度は $c$ 以上必要となる。しかしながら、近年、高出力化、高効率化を目的とし、永久磁石に高磁力の希土類磁石を使用することが多くなってきた。希土類磁石(Nd-Fe-B系、Sm-Co系、Sm-Fe系)は温度と減磁が図7(c)のような関係にあり、ある温度以上に加熱されると磁石が減磁し、圧縮機の性能が低下してしまう。これは、従来一般的だったフェライト磁石とは逆の特性である(フェライト磁石は高温ほど減磁に対する耐力が強い。ただし、キュリー温度以下)。

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## 【0013】

減磁開始温度は、磁石の種類（保磁力）、形状、寸法、鉄心の形状、エアギャップの大きさ等によって定まるパーミアンスによって異なるが、通常圧縮機用モータを設計する場合、必要保持力を確保しようとする、減磁によって制約されることが多く、減磁を防ぐために、コストをかけたり、モータ効率を落として減磁対策設計を施したり、回転子と回転軸を組み付けたあとに、磁石を着磁する製造工程に変更するなどしていた。製造工程の変更は、設備が大掛かりなものになるか、設備を簡略化するため、固定子巻線を利用して着磁する場合は、十分に着磁できなかったり、固定子巻線に大電流を流すため巻線にダメージを与えたりすることになる。近年、高効率化のために採用されている集中巻方式の固定子では特にこの傾向（着磁不十分、巻線ダメージ）が大きい。

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## 【0014】

しかしながら、この発明における圧縮機は、回転軸1の一部に切欠き部1aを設け、回転子6の内径部にも、相似形状の部分である切欠き嵌合い部11aを形成しているため、トルク保持力を大きくすることができる。

## 【0015】

図7(c)において、加熱温度bは、減磁しないか、又は多少減磁しても、圧縮機性能に影響を及ぼさない程度の減磁量であり、この温度b時の焼き嵌めトルク保持力は必要保持力Fcより小さな保持力Fbとなる。切欠き部1aとそれに嵌め合わされる切欠き嵌合い部11aは、このトルク保持力不足分 $F_c - F_b$ を補うものとなる。ここで温度bは温度a以上である。そうしなければ、焼き嵌めできないことになる。ここで、予め回転軸1を回転子内径よりも小さくしておき、焼き嵌めをせずにトルク保持力を切欠き部1aのみで持たせるということが考えられるが、切欠き部1aはトルク方向（回転方向）の保持はできるが、回転子6の上下方向の抜けに対しては保持できない。この発明は、軸方向の回転子抜けに対しては、焼き嵌めで保持し、回転方向のトルク保持については、焼き嵌め力を切欠き部1aで保持するものである。よって、温度bは軸方向の回転子抜けを防止できる保持力Fbを確保し、かつ、永久磁石が減磁によって特性上問題の出ない温度に設定される。

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## 【0016】

図8はこの発明の実施の形態1による他の圧縮機の回転軸を示す正面図である。図9はこの発明の実施の形態1による圧縮機の他の回転軸を示す上面図である。図において、円筒の回転軸1の一部を切欠き、第2の切欠き部1bを設け、回転方向の力を保持できる形状であれば良い。前記図1乃至図5に示したように円筒の回転軸の一部を単純にカットしたDカットが製造的は簡単で、コストが安価になる。

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## 【0017】

図10はこの発明の実施の形態1による他の圧縮機の回転軸を示す正面図である。図11はこの発明の実施の形態1による圧縮機の回転子を示す上面図である。図において、円筒の回転軸1の一部を切欠き、第3の切欠き部1cを設け、回転方向の力を保持できる形状であれば良い。

## 【0018】

また、図1、図8および図10に示す第1の切欠き部1a、第2の切欠き部1bおよび第3の切欠き部1cは、回転軸1の圧縮要素部2とは逆の端部に設けることが生産上最も効率が良い。

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## 【0019】

図12は、この発明の実施の形態1による他の回転子の鉄心を示す縦断面図である。図において、回転子鉄心7は、薄板の電磁鋼板12にカシメ突部13を回転子1径より大きい径でカシメの長辺を半径方向に一致して設け、多数枚積層して形成されている。この積層は、カシメ突部13を圧入し合うことによって、鉄心打抜き金型内で自動的にかしめられる。

## 【0020】

図13はこの発明の実施の形態1による他の回転子の鉄心を示す上面図、図14はこの発

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明の実施の形態 1 による他の回転子の鉄心のカシメ要部詳細図で、(a) は V カシメと呼ばれる突形状の要部上面図、(b) は V カシメと呼ばれる突形状の横断面図、(c) は角平カシメと呼ばれる突形状の要部上面図、(d) は角平カシメと呼ばれる突形状の横断面図である。図において、V カシメは x 軸方向は V 型の傾斜がついているため、x 軸方向のずれに対しては弱い、y 軸方向のずれには強いものとなっている。角平カシメは傾斜はついていないが、y 軸方向の方が、x 軸方向よりも長く抵抗が大きい、ずれに対しての耐力はあることになる。

#### 【0021】

この発明は、切欠き部 1 a によって回転方向のトルク保持力を持たせるものとなっているが、この時、回転軸 1 の切欠き部 1 a と円筒の部分との境界に対応する回転子鉄心部 7 a にせん断力を生じることになる。ここで、カシメ部 1 4 を回転子鉄心 7 の半径方向に長軸 (x 方向) を合わせれば、回転方向トルクによるせん断に対し保持を補うものになり、回転子の剛性を増加させるものとなる。

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#### 【0022】

また、カシメ形状はこの V カシメ、角平カシメに限らず、丸台形カシメなど、ずれに対する強度に差があれば、その高強度方向を回転方向トルクによるせん断を補う方向にすれば同様の効果を得ることができる。

#### 【0023】

なお、この発明に関わる圧縮機は図 3 に表わしたようなロータリ型式圧縮機に限るものでなく、レシプロ型、スクロール型、スクリュウ型などのタイプの圧縮機に採用できるものである。

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#### 【0024】

##### 【発明の効果】

以上のように、この発明によれば、軸方向一部に切欠き部を設けた円筒形の回転軸と、この切欠き部付きの回転軸と相似形状の内径形状を持つ回転子とを嵌め合い固定したので、永久磁石を減磁させないように回転子と回転軸を固着させ、回転方向トルクに耐えうる圧縮機を安価に製造できる。

##### 【図面の簡単な説明】

【図 1】この発明の実施の形態 1 による圧縮機の回転軸を示す断面図である。

【図 2】この発明の実施の形態 1 による圧縮機の回転軸を示す上面図である。

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【図 3】この発明の実施の形態 1 による圧縮機の回転子を示す断面図である。

【図 4】この発明の実施の形態 1 による圧縮機の回転子を示す横断面図で (a) はある。

【図 5】この発明の実施の形態 1 による回転軸と回転子を嵌め合わされた状態を示す断面図である。

【図 6】この発明の実施の形態 1 による回転軸と回転子を圧縮機に組込んだ状態を示す圧縮機の断面図である。

【図 7】この発明の実施の形態 1 による回転軸と回転子との加熱温度と内径膨張量、トルク保持力、減磁率の関係を示す特性図で、(a) は内径膨張量、(b) はトルク保持力、(c) は減磁率である。

【図 8】この発明の実施の形態 1 による他の例の回転軸を示す断面図である。

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【図 9】この発明の実施の形態 1 による他の例の回転軸を示す上面図である。

【図 10】この発明の実施の形態 1 による他の例の回転軸を示す正面図である。

【図 11】この発明の実施の形態 1 による他の例の回転子を示す上面図である。

【図 12】この発明の実施の形態 1 による他の回転子の鉄心を示す縦断面図である。

【図 13】この発明の実施の形態 1 による他の回転子の鉄心を示す上面図である。

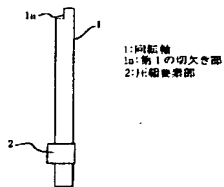
【図 14】この発明の実施の形態 1 による他の回転子の鉄心のカシメ要部詳細図で、(a) は V カシメ形状の上面図、(b) は V カシメ形状の横断面図、(c) は角平カシメ形状の上面図、(d) は角平カシメ形状の横断面図である。

##### 【符号の説明】

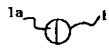
1 回転軸、1 a 切欠き部、2 圧縮要素部、3 電源端子、4 密閉容器、5 固定 50

子、6 回転子、7 鉄心、8 永久磁石、9 端板、10 リベット、11 回転軸挿入口、11a 回転軸切欠き部、11b 切欠き嵌合い部、12 電磁鋼板、13 カシメ突部。

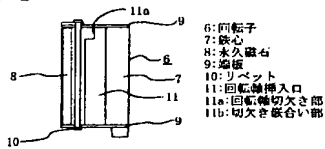
【図 1】



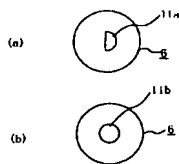
【図 2】



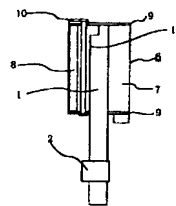
【図 3】



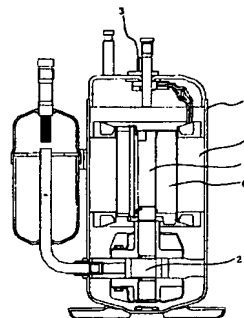
【図 4】



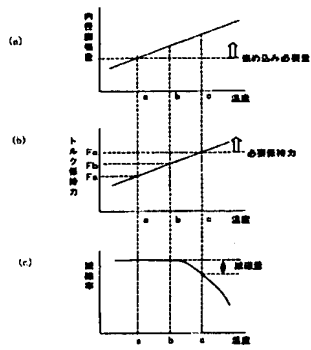
【図 5】



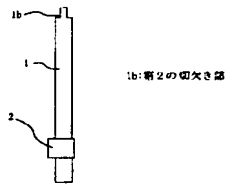
【図 6】



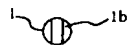
【図 7】



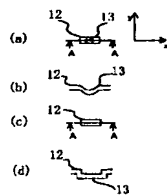
【図 8】



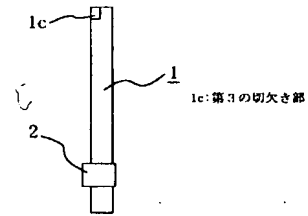
【図 9】



【図 14】



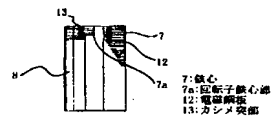
【図 10】



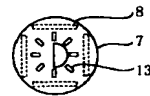
【図 11】



【図 12】



【図 13】



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フロントページの続き

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Fターム(参考) 3H003 AA05 AB04 AC03 BF00 CA01 CF05

3H029 AA04 AA12 AB03 BB11 BB31 BB32 CC16 CC27

【公報種別】特許法第17条の2の規定による補正の掲載

【部門区分】第5部門第1区分

【発行日】平成18年3月9日(2006.3.9)

【公開番号】特開2004-293336(P2004-293336A)

【公開日】平成16年10月21日(2004.10.21)

【年通号数】公開・登録公報2004-041

【出願番号】特願2003-83510(P2003-83510)

【国際特許分類】

F O 4 B 39/00 (2006.01)

F O 4 C 23/02 (2006.01)

F O 4 C 29/00 (2006.01)

【F I】

F O 4 B 39/00 1 O 3 D

F O 4 B 39/00 1 O 6 D

F O 4 C 23/02 E

F O 4 C 29/00 A

【手続補正書】

【提出日】平成18年1月20日(2006.1.20)

【手続補正1】

【補正対象書類名】明細書

【補正対象項目名】特許請求の範囲

【補正方法】変更

【補正の内容】

【特許請求の範囲】

【請求項1】 軸方向一部に切欠き部を設けた円筒形の回転軸と、この切欠き部付きの回転軸と相似形状の内径形状を持つ回転子とを嵌め合い固定したことを特徴とする密閉型圧縮機。

【請求項2】 嵌め合い固定に焼嵌めを用いたことを特徴とする請求項1記載の密閉型圧縮機。

【請求項3】 切欠き形状はDカットとしたことを特徴とする請求項1記載又は請求項2記載の密閉型圧縮機。

【請求項4】 切欠き軸方向位置は、回転軸端部に配置したことを特徴とする請求項1乃至請求項3記載の密閉型圧縮機。

【請求項5】 回転子は薄板を積層して構成され、その積層固定はカシメによって成され、そのカシメの長辺を半径方向に一致させて設けたことを特徴とする請求項1乃至請求項4記載の密閉型圧縮機。

【請求項6】 回転子に希土類磁石を配置することを特徴とする請求項1乃至請求項5記載の密閉型圧縮機。